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## Climate change determined humanity's global conquest

 20:00 17 September 2012 by **Michael Marshall**

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Humans may have conquered the world, but not without a big helping hand from climate change. A major study of the last 120,000 years of history reminds us that, while we are adaptable, our species is ultimately at the mercy of the climate.

*Homo sapiens* evolved in Africa around 200,000 years ago, but only [left the continent](#) about 70,000 years ago. After that our species rapidly went global, colonising first Europe and Asia, and then [Australasia](#) and [the Americas](#).

But why did early humans linger so long in Africa, and what spurred them to finally move? Several theories have been proposed, but according to a large effort to reconstruct the last 120,000 years of human history – including the climate we lived in and the vegetation we fed on – the current population spread around the planet would not be as it is without key changes in the climate.

### Food for forage

Geneticist [Andrea Manica](#) at the University of Cambridge, UK, and his colleagues teamed up with climate modellers, who simulated changes in temperature and rainfall across the planet over the last 120,000 years.

The climate modelling allowed the researchers to calculate changes in the vegetation in different regions, which gave an estimate of the amount of food available there.

The team then used this food supply data to drive a model of human population and migration. The model accurately reproduced the pattern and timings of human expansion out of Africa and across the continents, so far as it is known from the archaeological record – suggesting that climate and food supply were key elements needed to explain how humans spread worldwide.

### Roadblocks

The model also revealed that climate changes probably had a key role in lifting four major roadblocks to humanity's global takeover ([see map](#)).

The first and most important roadblock was the Arabian peninsula, an impassable desert that trapped humans in Africa for tens of thousands of years. Then, 70,000 years ago it began receiving more rain. The coastal areas became more fertile, allowing humans out of Africa. "Climate is a really good explanation for why they didn't make it out earlier," says Manica.

There are several conceivable routes out of Africa, but Manica's model suggests that the Arabian



The Arabian Peninsula stymied human migration for tens of thousands of years (*Image: Niels van Gijn/Getty Images*)

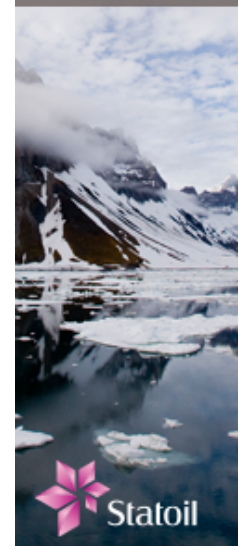
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coast was the most important exit route. After that, *H. Sapiens* clustered in what is now Iraq before heading off in different directions.

### Water trap

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One group expanded east into Asia, spreading south-east into Indonesia. There, they hit a second roadblock: high sea levels meant that wide stretches of open water separated the many islands. Manica assumed that crossings of 100 kilometres were a bridge too far, leaving pioneers no way to reach Australia.

That meant people could only go further once sea levels fell, exposing more patches of low-lying land and making for shorter sea journeys. The waters fell 60,000 years ago and then again 15,000 years later, as successive glaciations trapped more of the world's water at the poles.

The combined climate and vegetation model suggests *H. sapiens* probably only reached south-east Asia 45,000 to 50,000 years ago, which would rule out a crossing when sea levels fell for the first time.

### Getting colder...

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Further north, Manica's model suggests that humans reached Siberia by 30,000 years ago, where they were met by a vast ice sheet which prevented them from entering North America – the third roadblock. Not until 15,000 years ago did it shrink, allowing them into the Americas. Once in, they spread rapidly.

Back in Europe and Asia, populations faced one last roadblock: their local ice sheets. During warm periods humans went north into Scandinavia and northern Asia, but they were forced south when the ice advanced again.

To see just how sensitive our species has been to changes in climate over the ages, Manica ran the model several times, varying the strength of climate's effect on populations.

In parallel, he also modelled the history of human genetic variation, and compared that with real data on the genetic makeup of modern populations. Strikingly, he was only able to reproduce the known timings of migrations, and the real-world genetic data, if the human populations in his model were highly sensitive to the climate.

### Neanderthal brakes

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It's the first time anyone has been able to explore climate's power to facilitate human expansion, says [Rick Potts](#) of the Smithsonian National Museum of Natural History in Washington DC. "The study fills in many of the links that have only been assumed or guessed at," he says.

The model hits trouble in Europe, though. It predicts that humans arrived 55,000 years ago – 10,000 years before [the oldest archaeological evidence](#), from southern Italy. Manica says competition with Neanderthals could have slowed the modern humans down, or there might be older remains still to be discovered. "Or we could be wrong," he admits.

"There are inconsistencies," says [John Stewart](#) of Bournemouth University in the UK. "But the results are still remarkably good."

### Climate and collapse

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Stewart has proposed that earlier bouts of climate change helped the many hominin species to evolve, by forcing them into isolated refuges where they evolved separately (*Science*, [doi.org/jcz](https://doi.org/10.1126/science.1222277)). If that's correct, climate has been determining our fate for even longer than Manica's model suggests.

Manica argues that modern civilisation is still highly dependent on the climate. [Many societies have declined or collapsed when faced with climate change](#), for example.

While agriculture produces more food than hunting and gathering, and so supports more people, ultimately climate's effect on food production still limits our population. "We are very much governed by climate," he says.

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1209494109



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